Claims 5-10 were rejected under 35 U.S.C. §103(a) as being unpatentable over Dejonghe in view of Rakib et al., Bohnke, Rasky et al., and further in view of Klank et al. (United States Patent Number 6,226,337). Claim 11 was rejected under 35 U.S.C. §103(a) as being unpatentable over Dejonghe in view of Rakib et al., Bohnke, Rasky et al., and further in view of Van Nee (United States Patent Number 6,404,732). Claims 12-30 were rejected under 35 U.S.C. §103(a) as being unpatentable over Dejonghe in view of Rakib et al., Bohnke, Rasky et al., and further in view of Ohkubo, Klank and Van Nee.

Applicants note that, in the previous Office Action, the Examiner had cited Wood, Jr. (United States Patent Number 6,104,333) in rejecting claims 1-3 and, in the present Office Action, cites Rasky et al. in regard to the same limitations of the same claims. In the present Office Action, the Examiner then cites Wood, as applied to claim 1, in the rejections of claims 4-30 and provides no additional information on the Wood reference, such as U.S. Patent serial number. Applicants assume the Examiner meant to cite Rasky et al. instead of Wood, Jr. in rejecting claims 4-30.

The present invention is directed to techniques for estimating the frequency offset and interleaver synchronization in an OFDM communication system. Certain locations in an OFDM frame, such as adjacent bins, are allocated to a signature sequence. Data is differentially encoded in frequency, so that said frequency offset and interleaver synchronization can be estimated from a single OFDM frame. The frequency offset is estimated at a receiver by determining whether a correlated peak associated with said signature sequence is in an expected location. A beginning of an interleaver block is identified based on a location of a correlated peak associated with the signature sequence.

<u>Independent Claims 1, 12, 22, 29 and 30</u>

Independent Claims 1-3 were rejected under 35 U.S.C. §103(a) as being unpatentable over Dejonghe in view of Rakib et al., and further in view of Bohnke and Rasky et al.

The Examiner asserts that Rasky teaches the differential encoding of the synchronization word (as shown in col. 4, lines 29-56; col. 4, lines 13-28; col. 4, lines 57-61).

Applicants note that the differential encoding taught by Rasky is performed in time, not in frequency. Rasky teaches that "this synchronization sequence preferably is transmitted over a

communication channel periodically on *a predetermined frequency*." Col. 4, lines 45-47. Rasky does not disclose or suggest that a signature sequence is differentially encoded/decoded in frequency. Each of the independent claims of the present invention emphasize that differential encoding/decoding of the signature sequence is performed in *frequency*.

Thus, Rasky et al. do not disclose or suggest "transmitting said signature sequence with data to a receiver wherein said data and signature sequence are encoded using a differential encoding performed in frequency," as required by independent claims 1 and 22. Similarly, Wood does not disclose or suggest "wherein said received digital signal (that contains a signature sequence in an expected location) is encoded using a differential encoding performed in frequency," as required by independent claims 12, 29 and 30.

The Examiner further asserts that Dejonghe discloses a method for estimating the frequency offset in an OFDM communication system, comprising the steps of: allocating certain locations to a signature sequence (Citing Figs. 1 and 2); transmitting said signature sequence with data to a receiver; and estimating the frequency offset at said receiver by determining whether a correlated peak associated with said signature sequence is in an expected location.

Furthermore, the Examiner asserts that Bohnke teaches the transmitting and receiving of the power control information in the slot frames of the OFDM system "using a differential method to modulate the data for the power control information (abstract). The information transmitted including the phase reference information (signature sequence) and the power control information (differentially encoded data)."

Applicants acknowledge that Bohnke transmits the power control information using a differential method. The phase reference information, however, which the Examiner compares to the signature sequence of the present invention, is <u>not</u> transmitted using a differential method. Bohnke teaches "one of said subcarriers, for example the first subcarrier in a respective number of subcarriers...carries a phase reference information, if the information is differential phase modulated." Col. 1, lines 40-44. Thus, if the data being transmitted is differential phase modulated, the phase reference information is transmitted on one of the subcarriers. For example, Figure 1 shows "the first subcarrier shown in said frequency slot is a phase reference subcarrier 1 carrying a phase reference information...(and) the second subcarrier 2 carries a differential encoded power

control information." Col. 1, lines 52-56. Thus, Bohnke does not disclose or suggest "transmitting said signature sequence with data to a receiver wherein said data *and said signature sequence* are encoded using a differential encoding performed in frequency," as required by independent claims 1 and 22, and does not disclose or suggest "wherein said received digital signal (that contains a signature sequence in an expected location) is encoded using a differential encoding performed in frequency," as required by independent claims 12, 29 and 30.

In addition, as shown in FIGS. 1 and 2, Dejonghe differentially encodes the signal in *time* (vertically in FIG. 1), by comparing corresponding bins (or carriers) of two adjacent frames (or symbols) C_0 and C_1. Thus, a single frame (or symbol) cannot be decoded at the receiver until the second frame arrives. In addition, the frequency offset cannot be determined unless multiple frames are received. See, also, mathematical expression 1, at col. 4, line 34, where it is clear that the differential value is C_1 multiplied by the complex conjugate of C_0.

As previously stated, each of the independent claims of the present invention emphasize that differential encoding/decoding of the signature sequence is performed in frequency. Therefore, the present invention allows the frequency offset to be estimated from a single frame. In other words, the present invention encodes the data and signature sequence of a single frame differentially across the bins (or subcarriers) in frequency, while Dejonghe encodes data differentially between the bin of one frame and the corresponding bin of another frame.

Thus, Dejonghe does not disclose or suggest "transmitting said signature sequence with data to a receiver wherein said data and signature sequence are encoded using a differential encoding performed in frequency," as required by independent claims 1 and 22. Similarly, Dejonghe does not disclose or suggest "wherein said received digital signal (that contains a signature sequence in an expected location) is encoded using a differential encoding performed in frequency," as required by independent claims 12, 29 and 30.

<u>Additional Cited References</u>

Rakib has been cited by the Examiner for its disclosure of details on an interleaver. Rakib does not disclose or suggest techniques for estimating the frequency offset or interleaver synchronization in an OFDM communication system, using differential decoding in frequency.

Ohkubo has been cited by the Examiner for its disclosure of frequency offset correction in an OFDM communication system. Ohkubo does not disclose or suggest techniques for estimating the frequency offset or interleaver synchronization in an OFDM communication system, using differential decoding in frequency.

Klank has been cited by the Examiner for its disclosure of transmitting digital frames using multiple modulated carriers having a given reference frequency pattern. Klank does not disclose or suggest techniques for estimating the frequency offset or interleaver synchronization in an OFDM communication system, using differential decoding in frequency.

Van Nee has been cited by the Examiner for its disclosure of a digital modulation system that provides enhanced multipath performance using modified orthogonal codes. Van Nee does not disclose or suggest techniques for estimating the frequency offset or interleaver synchronization in an OFDM communication system, using differential decoding in frequency.

<u>Dependent Claims</u>

Dependent Claims 2-11, 13-21 and 23-28 were rejected under 35 U.S.C. §103 as being unpatentable over various combinations of Dejonghe, Rakib et al., Bohnke, Rasky et al., Ohkubo, Klank and Van Nee. Claims 2-11, 13-21 and 23-28 are dependent on Claims 1, 12 or 22, and are therefore patentably distinguished over Dejonghe, Rakib et al., Bohnke, Rasky et al., Ohkubo, Klank and Van Nee (or any combination thereof) because of their dependency from amended independent Claims 1, 12 or 22 for the reasons set forth above, as well as other elements these claims adds in combination to their base claim.

In view of the foregoing, the invention, as claimed in Claims 1-30, cannot be said to be either taught or suggested by Dejonghe, Rakib et al., Bohnke, Rasky et al., Ohkubo, Klank and Van Nee (or any combination thereof). Accordingly, applicants respectfully request that the rejection of the claims under 35 U.S.C. §103 be withdrawn.

All of the pending claims, i.e., claims 1-30, are in condition for allowance and such favorable action is earnestly solicited.

If any outstanding issues remain, or if the Examiner has any further suggestions for expediting allowance of this application, the Examiner is invited to contact the undersigned at the telephone number indicated below.

The Examiner's attention to this matter is appreciated.

Respectfully submitted,

Kevin M. Mason

Date: October 27, 2003

Kevin M. Mason
Attorney for Applicants
Reg. No. 36,597
Ryan, Mason & Lewis, LLP
1300 Post Road, Suite 205
Fairfield, CT 06824
(203) 255-6560